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Ju Do (柔道) as a Complementary Therapeutic Tool for Parkinson's Disease: a Quantitative Single-Study Case

By Attilio Sacripanti[1], Envic Galea[1], Romeo Fabi[2]

Abstract: *This paper describes a quantitative, single-case study applied to Parkinson's Disease, which was born from a research project of the IJF Academy Foundation. The case study was centred around a 66-year-old retired man, height 1.65 m, weight 87 kg. He is a fifth dan judo black belt with akinetic Parkinson's and Pisa Syndrome, high lateral torsion (~14°) and balance problems.*

This article describes the protocol used and quantitative results obtained. The experimental data collected indicates that a judo sequence called gensoku no genkei (原則の原型) can be useful, in its safe form, as a therapeutic tool at any stage of Parkinson's Disease. The lack of a potential painful state after the sequence, the quantitative improvement in standard senior tests, and in some specific tests based on ukemi (breakfall techniques), improvement of the Pisa Syndrome angle and the persistence of results obtained, demonstrate the effectiveness of this application of judo for Parkinson's.

The method led to an improvement in daily quality of life, clearly demonstrating the validity of judo and specifically of gensoku as a reparative therapy for functional improvement, even in the advanced stages of Parkinson's Disease.

Keywords: *Parkinson's disease; physical therapy; Gensoku no Genkei; therapeutic tool, quantitative study*

The IJF Academy Foundation is the educational arm of the International Judo Federation and its primary goal is to provide professional education for coaches and standardise their technical knowledge, spreading the judo values, knowledge and an understanding of different applications of judo worldwide. During the last four years, the IJF Academy has tried to diversify the application of judo, given its great adaptability and technical richness, in various fields beyond competitiveness, developing research projects such as safe falling for the elderly (EDJCO Project 2021-2023) and intergenerational integration (JOY Project 2024-2026). Among these projects, special attention was paid to the rehabilitative use of judo in general, with the Parkinson's project is a practical example. This project focused on the analysis of judo's potential effectiveness in a quantitative case study, of which this article is the report. The conclusions are that judo as a specific sequence called *gensoku no genkei* can rehabilitate a patient with Parkinson's disease.

PARKINSONS'S, CURRENT AND NEW HORIZONS: *GENSOKU* AS A THERAPEUTIC TOOL

The rehabilitative goal for patients with Parkinson's Disease is to maximise functional independence and, if possible, enhance their quality of life at all stages of the disease. Balance exercises are normally introduced from an early stage of the disease, to become part of the daily habit of yoga exercise (Van Hulsteyn et al., 2013). Higher-level balance training, such as that provided by tai chi, is also common (Hallet and Poewe, 2008).

Judo can be used for balance issues and the prevention of falls in Parkinson patients (Seminara et al., 2022). Dance therapy has been observed to be beneficial and may have long-lasting effects. In particular, tango training improved mobility and other motor domains (Zafar et al., 2016; Seidler et al.,2016; Wang et al.,2022).

Judo falling techniques (*ukemi*) can be extended, with appropriate precautions, to help the elderly with Parkinsons, as in this case study.

Animal and human studies have revealed that exercise enhances cognition via neurotrophin and catecholamine production, which are known to mediate neural plasticity and energy metabolism in the brain (Gomez-Pinilla et Hillman 2018). It has also been shown that physical training benefits functional connectivity in the medial and lateral temporal cortices (Voss et al., 2013).

One study demonstrated that rodents that participated in complex motor skill learning tasks exhibited a greater num-

Authors' affiliations:
1. International Judo Federation Academy Foundation, Malta
2. Independent Researcher Italy

ber of synapses per neuron, a substantially greater volume of molecular layers per Purkinje neuron, and a sufficiently large number of other geometric fractals, such as capillaries (Sacripanti, 2000). Furthermore, in the cerebellum, they showed a significantly greater number of parallel fibres in Purkinje cells, a well-known example of physiological self-organisation (Sacripanti, 2000), compared to animals that simply walked or were inactive (Isaacs et al., 1992).

Exploiting the qualities inherent in judo, a new kata has been developed (an. evolution of the *Itsutsu-No-Kata*), based on the two philosophical principles of judo: *Jita kyoei* (自他共榮) and *Seirioku Zenyo* (精力善用). *Gensoku-No-Genkei* (原理の原型), the archetype of the principle, (Sacripanti, 2022) developed in three forms ('hard,' 'gentle' and 'safe,' is the simplest set of movements, biomechanically speaking, grouped into an open *kata* (形) .

In its safe form, it can be used as a preventive tool for children or older adults, to understand the use of basic forces and assisted falls while moving, and for PD rehabilitation. *Gensoku-No-Genkei* requires high levels of perceptual, cognitive and adaptive processes such as attention, concentration, postural control, co-ordination with a partner and bilateral execution, which facilitates cognitive processing and slows the degradation of movement in PD.

Recent studies have demonstrated important brain connections for judo (Wantuir et Jacini, 2007; Wantuir et al. 2009). Young judoka show a different fractional anisotropy of white matter when compared with healthy people, which means that judo practice influences the brain for better connectivity between different areas (Toh et al., 2018).

The largest-ever clinical study of Parkinson's suggests that people with PD perform at least 2.5 hours of exercise every week for a better quality of life. (Jankovic et Tolosa, 2015). Another study showed that training two or three times a week is the best dosage for PD; in fact, training subjects with PD five days a week seems ineffective, as no improvement was observed. (Auxiliadora de Paula Vasconcelos 2020).

An exercise programme must include a tailored recovery time to help manage the PD symptoms. Many types of exercises can be performed, such as running and walking, biking, tai chi, yoga, pilates or dance, weight training, and non-contact boxing (Keus et al., 2014). Motor control function is also known. Although we understand some of these aspects, the full subtleties are yet to be explored. For example, the Substantia Nigra contains a large number of neurones that contain neuromelanin. Its main function is to produce dopamine, a crucial neurotransmitter for motor and movement control, cognitive executive function and emotional limbic activity (Ken Hub- Anatomy Substantia Nigra n.d.). Degeneration of this structure leads to Parkinson's syndrome (WHO -Parkinson disease n.d.). The interplay between Purkinje cells and the Substantia Nigra involves reward processing, motor control and cognitive functions (Kostadinov et Hausser, 2022) Further research is required to determine the intricacies of this interaction. A recent paper, the first study to explain the neurophysiology of transition in motor control networks, demonstrated the transition in connectivity between motor-related areas, according to movement states. Specifically, during the motor planning state, connectivity increased in most motor-related areas (Yeom et al., 2020)

Movement and exercise can have a significant impact on the substantia nigra in individuals with Parkinson's. Research has shown that exercise can help improve the functionality of dopaminergic neurons in the substantia nigra, which are crucial for motor control and are progressively lost in Parkinson's. One study showed an increase in dopamine transporter availability in the substantia nigra and striatum. This suggests improved functionality of the remaining dopaminergic neurons and an increase in neuromelanin concentration in the substantia nigra, which is associated with healthier dopaminergic neurons (de Laat et al., 2024).

Exercise also has neuroprotective effects that induce the activation of neurotrophic factors, such as brain-derived neurotrophic factor (BDNF) and nuclear factor (erythroid-derived 2)-like 2 (NRF2), which help protect neurons from oxidative stress and ferroptosis, a type of cell death. This can slow the progression of Parkinson's disease (Thirupathi et al., 2024) Furthermore, regular, moderate to high intensity exercise has been shown to ameliorate motor symptoms in Parkinson's patients, likely due to the neuroprotective and neurorestorative effects on the substantia nigra. (Palasz et al. 2019). Such information might help to uncover complex mechanisms, which gives hope regarding the potential benefits of movement interventions in PD, using more complex structures such as *Gensoku*.

CASE STUDY

Before starting the study case, the subject received sufficient and complete information about the potential risks and benefits of treatment through the Informed Consent Module.

Patient profile: RF, a retired, 66-year-old, height 1.65 m, weight 87 kg, practising judo since 1970, 2020 5th dan black belt.

Symptoms: Parkinson's akinetic form with high lateral torsion (~14°), Pisa Syndrome (Etoorn et al., 2020) and balance issues.

Intervention: Patient received physiotherapy, including *Gensoku no Genkei* as tori (executing techniques) and *uke* (receiving the techniques), from the left and right sides, a 9-week follow-up.

Outcomes: These outcomes provide insights into special rehabilitation management for Parkinson's. This single case study highlights the importance of more complex and bilateral physical activity and treatments in minimising and delaying the progression of symptoms in patients with Parkinson's.

History of present illness (HPI): Diagnosis of Akinetic Parkinson's Disease 28.2.2023, left-hand tremor (~5 months), decreased balance (~1 year), and Pisa Syndrome (Etoorn et al., 2020).

Past medical history included: Complete left brachial block 16.11.2019, and left convex roto-scoliosis of the distal lumbar spine.

Medications: He received a prescription and training for 'Levadopa,' reduced at his request (he does not believe that he needs additional doses).

Health habits: Non-smoker, occasional moderate alcohol consumption.

Current functional status: Since the onset of PD symptoms, he stopped every gymnastic or judo application for 16 months, with a dramatic worsening of his body's condition. He drives when necessary but with two safety belts and is less confident with reaction time. He is less confident walking outside, has problems with stairs and problems with bed mobility.

The timely execution of the proposed protocol, varied appropriately in the presence of critical issues that were gradually identified, highlighted a significant improvement in the initial functional state. Currently, he only wears the seatbelt required by law and his driving posture is improved. To walk outside and around the house, he needs the help of a walking stick or typical walker. He is still tiring to go up and down stairs and dress. There is improvement in his mobility in bed and showering but with slow movement.

PROTOCOL RATIONALE

The rationale of the protocol is based on the use of *Gensoku*, given its similarities to classic exercises for Parkinson's Disease (Abraham, 2022; Smith, 2019). See Figure 1.

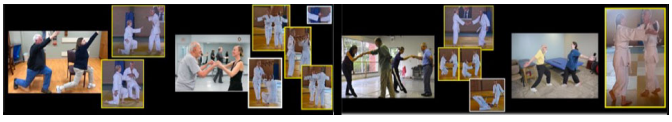


Figure. 1 Similarities between Parkinson's exercises and *Gensoku*

For Parkinson's affected patients, it is recommended to train on both sides, therefore performing *Gensoku No Genkei*, as *tori* and *uke*. *Gensoku* is carried out twice a week with recovery and warm-up based on the literature, which indicates that physical therapy distributed twice a week is effective for patients with Parkinson's Disease (Auxiliadora de Paula Vasconcelos, 2020). We also experimentally verified that a high dose of exercise, without adequate recovery, deteriorates performance.

A problem with evaluating the effectiveness of *Gensoku* objectively, quantitatively and without wearable instruments that are cumbersome and annoying to the subject was solved using video. We filmed all executions and evaluated their global time, various partial times (e.g. time to get up from the ground after falling), and the times of some classic and new tests. We also measured Pisa Syndrome deviation, testing if there were any benefits or changes over time.

Therefore, the optimal rhythm was found by having the subject performing *Gensoku* as *tori* and *uke* twice a week, on the right one day and on the left on the other. Previously, we tried one day as *tori* on the right and left and the following day on the right and left as *uke* but the physical load was shown to be too unbalanced, causing excessive physical stress on the second day.

During another week, on a day of rest, the subject walked to reach the hospital therapy pavilion, where he received mild standard therapy. However, the overall effort from the long walk and mild therapy produced a significant deterioration in the performance of *Gensoku* the day after.

From our experiments, it is clear that the recovery time between exercises, in addition to being personalised, must also be appropriately modulated according to the Hoehn and Yahr scale (Zhao et al. 2010) and with PD evolution. The protocol provides a fixed frequency (once every week) for a series of Standard Fitness Tests (Rikli et Jones 2013), with the addition of specific judo tests to monitor variations. The two Standard Tests were the up-and-go test and the twenty metres walking test (Rikli et Jones 2013). The Specific Judo Tests were migi *yoko ukemi* (falling to the right side), *hidari yoko ukemi*, (falling to the left side) and *ushiro ukemi* (falling backwards), (Sacripanti, 1989). However, these tests are not evaluated as the time of falling but rather as the time taken to return to standing from the ground position.

Other tests were performed at the end of three months of experience: two batteries of six Senior Standard Tests and the self-screening 'Healthy Survey F-36' (G.L.O.B.E. fisioscience, 2022). After one month, the subjects performed *Gensoku* again, verifying the persistent improvement obtained. The standard weeks (Table 1) were as follows.

Table 1. *Gensoku* validation protocol utilised in this case study

EXECUTION PROTOCOL WITH GENSOKU NO KATA (Dose: Two Times A Week)			
FIRST DAY	SECOND DAY	ONCE A WEEK	EXCEPTION IF THE SUBJECT IS TIRED OR NOT ABLE TO PERFORM ALL THE SEAMLESS SEQUENCE
10 minutes of warm up Gensoku no kata as Tori (dx) Gensoku no kata as Uke (dx) 15 minutes of recovery in between	10 minutes of warm up Gensoku no kata as Tori (sx) Gensoku no kata as Uke (sx) 15 minutes of recovery in between. END OF THE WEEK	Two Standard tests 15 minutes of recovery Three judo Falling Tests 10 minutes cool down	If necessary, Gensoku performance as Uke can be split in two parts with five minutes of recovery, in between

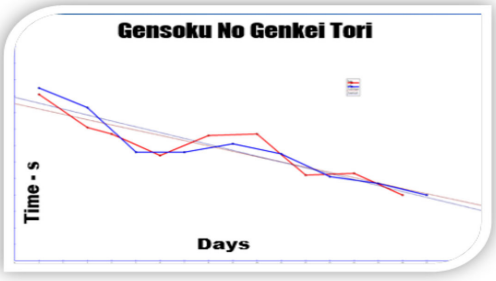
EXPERIMENTAL RESULTS

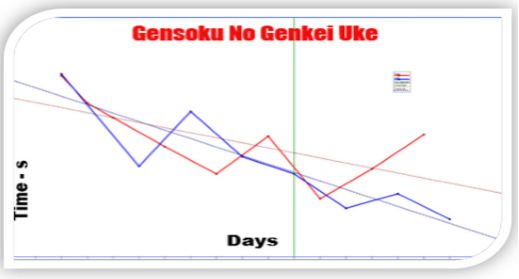
Gensoku evaluation

To develop an objective evaluation of the use of *Gensoku* as a tool to support the medical therapies used for Parkinson's Disease, it was decided after an appropriate and in-depth analysis to film the subject of the study and at different times deemed interesting for the purpose. The following tables show the data related to seven weeks of exercise (Table 2-7). Such data was graphed and analysed in order to identify the effects of *Gensoku*.

Table 2. *Gensoku* experiment times

TEST : gensoku no genkei Uke					
Date	Week	Test	Side	Value	Notes
05/10/2022	0	Tori	right	00:02:44	First stage of disease
05/02/2024	1	Tori	right	00:03:41	
05/02/2024	1	Tori	left	00:03:45	
07/02/2024	1	Uke	right	00:06:52	
07/02/2024	1	Uke	left	00:06:54	
12/02/2024	2	Tori	right	00:03:21	
12/02/2024	2	Tori	left	00:03:33	
12/02/2024	2	Uke	right	00:06:20	
12/02/2024	2	Uke	left	-	
19/02/2024	3	Tori	right	00:03:17	
21/02/2024	3	Tori	left	00:03:06	
19/02/2024	3	Uke	right	00:06:03	
21/02/2024	3	Uke	left	00:05:28	
26/02/2024	4	Tori	right	00:03:04	
28/02/2024	4	Tori	left	00:03:06	00:03:26 (Falled)
26/02/2024	4	Uke	right	00:05:29	
28/02/2024	4	Uke	left	00:06:10	
04/03/2024	5	Tori	right	00:03:16	
06/03/2024	5	Tori	left	00:03:11	00:03:26 (Falled)
04/03/2024	5	Uke	right	00:04:57	
06/03/2024	5	Uke	left	00:05:17	
11/03/2024	6	Tori	right	00:03:17	
18/03/2024	7	Tori	left	00:03:05	
11/03/2024	6	Uke	right	00:05:41	
18/03/2024	7	Uke	left	00:04:57	5 to 5 (mid rest)
20/03/2024	7	Tori	right	00:02:52	
		Tori	left		
20/03/2024	7	Uke	right	00:04:28	5 to 5 (mid rest)
		Uke	left		5 to 5 (mid rest)





Graphs 1. and 2. Times/ days *Gensoku* time and trends

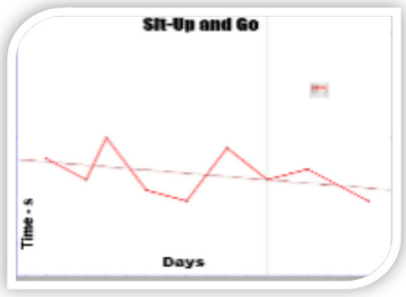
The decreasing trends in the graphs indicate that the subject tended to improve both the global execution speed and specific co-ordination during the execution of *Gensoku*.

Test evaluation

Similar to the classical tests, the trends showed an equally decreasing course, confirming slow but constant improvement.

Table 3. Classical tests times

Date	Week	Test	Side	Value	Notes
05/02/2024	1	sit up and go	-	00:00:18	3m distance
05/02/2024	1	walk test	-	00:00:26	20m distance
05/02/2024	1	fall and sit up	back	00:00:21	back up on favourite side
05/02/2024	1	fall and sit up	right	00:00:21	
05/02/2024	1	fall and sit up	left	00:00:27	
12/02/2024	2	sit up and go	-	00:00:16	3m distance
12/02/2024	2	walk test	-	00:00:21	20m distance
12/02/2024	2	fall and sit up	back	00:00:19	taken from gensoku (uke)
12/02/2024	2	fall and sit up	right	00:00:16	taken from gensoku (uke)
12/02/2024	2	fall and sit up	left	x	failed (excessive stress)
19/02/2024	3	sit up and go	-	00:00:20	3m distance
19/02/2024	3	walk test	-	00:00:20	20m distance
19/02/2024	3	fall and sit up	back	00:00:32	(right)
19/02/2024	3	fall and sit up	right	00:01:02	get up from weak leg (failed before)
19/02/2024	3	fall and sit up	left	00:00:26	
26/02/2024	4	sit up and go	-	00:00:15	3m distance
26/02/2024	4	walk test	-	00:00:18	20m distance
26/02/2024	4	fall and sit up	back	00:00:32	(right)
26/02/2024	4	fall and sit up	right	00:00:35	get up from weak leg
26/02/2024	4	fall and sit up	left	00:00:24	3m distance
04/03/2024	5	sit up and go	-	00:00:14	20m distance
04/03/2024	5	walk test	-	00:00:18	(right)
06/03/2024	5	fall and sit up	back	00:00:15	get up from weak leg
06/03/2024	5	fall and sit up	right	00:00:18	
06/03/2024	5	fall and sit up	left	00:00:12	First attempt: Failed
11/03/2024	6	sit up and go	-	00:00:19	Second Attempt: 00:00:26
11/03/2024	6	walk test	-	00:00:24	20m distance
11/03/2024	6	fall and sit up	back	00:00:28	(right)
11/03/2024	6	fall and sit up	right	00:00:34	
11/03/2024	6	fall and sit up	left	-	
20/03/2024	7	sit up and go	-	00:00:16	hands help (on chair)
20/03/2024	7	walk test	-	00:00:21	20m distance
20/03/2024	7	fall and sit up	back	00:00:15	(right)
20/03/2024	7	fall and sit up	right	00:00:12	
20/03/2024	7	fall and sit up	left	00:00:10	



Graphs 3 and 4. Times/ days classical tests time and trends

Table 4. Dx rise time

SURVEY OF RISE TIMES IN THE EXECUTION AS UKE (RIGHT AND LEFT)
WITH ANALYSIS ON THE IMPROVEMENT (NUMERIC AND %) TOTAL AND PER SINGLE FALL

(1) Values detected and calculated in seconds, hundredths of seconds (2) total times in minutes, seconds

EXECUTION		E.right 1	E.right 2	E.right 3	E.right 4	E.right 5	E.right 6	E.right 7	E.right 8	E.right 9	E.right 10
RIGHT		Single						in 2 parts			
	date	07-feb	12-feb	19-feb	26-feb	04-mar	11-mar	20-mar	27-mar	05-apr	10-apr
T	Tright1	19,00	36,51	17,29	15,96	18,98	21,46	11,66	19,80	16,68	16,68
e	Tright2	14,41	12,10	11,22	13,56	11,56	13,80	12,07	30,83	16,91	16,03
c	Tright3	21,42	14,17	16,85	11,22	11,80	16,10	13,83	13,25	18,47	13,68
h	Tright4	22,95	16,10	18,87	9,73	12,37	11,36	12,71	10,81	17,56	11,63
n	Tright5	20,61	16,91	17,05	12,41	10,71	16,34	11,73	12,07	22,17	15,52
i	Tright6	23,50	20,03	18,51	13,42	10,74	20,88	10,03	14,91	15,80	14,58
q	Tright7	22,64	16,47	18,13	12,61	16,71	20,85	8,61	11,52	17,39	14,30
u	Tright8	20,37	17,66	13,08	14,58	15,02	17,93	12,00	10,95	9,93	8,44
e	Tright9	22,57	19,35	16,44	15,86	12,58	15,02	8,51	12,74	20,03	14,30
	Tright10	16,27	19,83	15,15	15,90	16,03	20,64	10,88	14,00	31,25	14,78
	VALUES:										
(2) -	TOTAL	3,23	3,09	2,42	2,15	2,16	2,54	1,52	2,31	3,06	2,20
(1) -	MEDIUM	20,37	18,91	16,26	13,53	13,65	17,44	11,20	15,09	18,62	13,99

Table 5. Sx rise time

EXECUTION		E.Left 1	E.Left 2	E.Left 3	E.Left 4	E.Left 5	E.Left 6	E.Left 7	E.Left 8
LEFT		Single				in 2 parts			
	date	07-feb	21-feb	28-feb	06-mar	18-mar	25-mar	03-apr	08-apr
T	Tleft1	28,30	13,19	32,25	25,12	11,05	11,76	18,91	8,30
e	Tleft2	34,84	10,20	12,00	12,13	11,86	9,86	11,36	10,91
c	Tleft3	19,05	11,42	21,49	10,95	8,27	11,29	12,64	9,63
h	Tleft4	20,41	10,95	17,56	10,74	14,17	9,25	14,61	9,73
n	Tleft5	16,24	16,07	16,30	17,76	11,60	10,41	11,76	12,68
i	Tleft6	18,47	18,74	19,05	13,97	9,96	9,42	8,24	8,34
q	Tleft7	18,10	16,85	14,34	15,39	11,97	13,86	8,27	8,34
u	Tleft8	24,64	17,56	18,61	17,52	13,86	14,13	9,36	14,44
e	Tleft9	20,10	17,12	15,66	13,80	14,34	9,56	10,74	9,25
	Tleft10	18,52	17,32	19,69	13,12	32,00	15,05	16,88	14,71
	VALUES:					ATTILIO			
(2) -	TOTAL	3,38	2,29	3,07	2,35	1,52	1,54	2,02	1,46
(1) -	MEDIUM	21,87	14,94	18,70	15,05	13,91	11,46	12,28	10,63

Tabels 6. and 7. Rise time for *Gensoku* as uke

RIGHT — **DATA ANALYSIS**

NUMERICAL AVERAGE			best % reference to maximum		
General	Single	2 Parts	[*] (M-m)/M	Single	2 parts
19,40	21,53	16,21	68%	56%	41%
15,25	12,78	18,96	64%	22%	61%
15,08	15,26	14,81	48%	48%	28%
14,41	15,23	13,18	58%	58%	38%
15,55	15,67	15,37	52%	48%	47%
16,24	17,85	13,83	57%	54%	37%
15,92	17,90	12,96	62%	44%	50%
14,00	16,44	10,33	59%	36%	30%
15,74	16,97	13,90	62%	44%	58%
17,47	17,30	17,73	65%	27%	65%

How much in % does it improve total time to get up **53%**
How much in % does it improve average time to get up **45%**
[*] (Maximum value - minimum value)/ Maximum value

LEFT — **DATA ANALYSIS**

NUMERICAL AVERAGE			best % reference to maximum		
General	Single	2 Parts	[*] (M-m)/M	Single	2 parts
18,61	24,72	12,51	74%	59%	56%
14,15	17,29	11,00	72%	71%	17%
13,09	15,73	10,46	62%	49%	35%
13,43	14,92	11,94	55%	47%	37%
14,10	16,59	11,61	41%	10%	18%
13,27	17,56	8,99	57%	27%	17%
13,39	16,17	10,61	54%	21%	40%
16,27	19,58	12,95	62%	29%	35%
13,82	16,67	10,97	54%	31%	35%
18,41	17,16	19,66	59%	33%	54%

How much in % does it improve total time to get up **57%**
How much in % does it improve average time to get up **51%**
[*] (Maximum value - minimum value)/ Maximum value

In the next table (8), the best, the worst and the average time of *Gensoku* performance, and date from the tests carried out in Table 9, are compared, to best evaluate improvement obtained.

Table 8. Best, worst and mean performance obtained in the tests

Tests	Side	Best (m)	Date	Worst (m)	Date	Mean(m)
Gensoku no Genkei Tori	right	2.40	05/04/2024	3.41	05/02/2024	3.09
	left	2.40	08/04/2024	3.45	05/02/2024	3.07
Sit up and go	-	0,14	08/04/2024	0.20	19/02/2024	0.16
Walk test	-	0.18	04/03/2024	0.26	05/02/2024	0.20
Fall and get up	back	0.12	03/04/2024	0.32	19/02/2024	0.21
	right	0.12	20/03/2024	1.02	19/02/2024	0.25
	left	0.09	03/04/2024	1.35	10/04/2024	0.29
Gensoku No Genkei Uke	right	4.28	20/03/2024	6.52	05/02/2024	5.37
	left	4.04	08/04/2024	6.54	05/02/2024	5.12

Therefore, for *Gensoku* on right and left, we obtain practically the same average increase in co-ordination

Table 9. Improvement percentage after three month

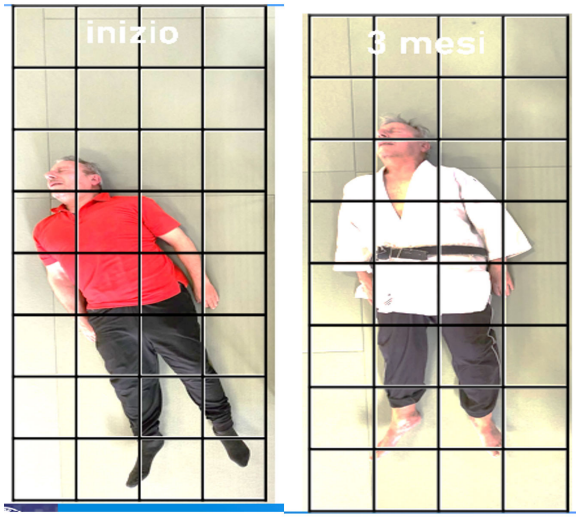
Gensoku No Genkei				
as Tori				
	Right	**best/ worst 29.6%**	**best / average 22%**	**average/ worst 9%**
	Left	**best/ worst 30%**	**best / average 21.8%**	**average/ worst 11%**
as Uke				
	Right	**best/ worst 34%**	**best / average 20%**	**average/ worst 17%**
	Left	**best/ worst 38%**	**best / average 21%**	**average/ worst 21%**
Tests Performed				
	Sit up and go	**best/ worst 20%**	**best / average 12%**	**average/ worst 20%**
	Walk	**best/ worst 30%**	**best / average 10%**	**average/ worst 23%**
Judo fall and get up				
	Back	**best/ worst 62%**	**best / average 42.8%**	**average/ worst 34%**
	Right	**best/ worst 88%**	**best / average 52%**	**average/ worst 75%**
	Left	**best/ worst 93%**	**best / average 64%**	**average/ worst 78%**

Pisa Syndrome (PS) (Harpreet et al., 2004; Tinazzi et al., 2016; Mimura et al., 2020) is a rare, reversible neurological disorder characterised by sustained muscle contractions that lead to abnormal posture and body twisting. In our case, lateral bending of the trunk tended to lean towards the right side. PS is a common and often disabling complication of Parkinson's..

Although no consistent diagnostic criteria for PS are available, most investigators have adopted an arbitrary cut-off of 10° lateral flexion for diagnosis. However, the mechanisms underlying PS have not yet been fully elucidated. Several drugs, including anti-Parkinsonian drugs, have been reported to induce PS. PS can cause severe and irreversible mechanical constraints affecting respiration, mobility and postural stability of the affected subject.

In our case study, the subject showed Pisa Syndrome with torsional, lateral bending on the right side of 14°.

After three months of *Gensoku* application, 10 complete executions, as *tori* and *uke*, PS decreased to 11° without any specific previously reported medical trials.



Figures 2. and 3. Before and after 3 months

Senior Fitness Tests (Rikli et Jones 2013), SFT were used in multiple areas. Given that the exercises require minimal equipment and space, (a larger space is required for the 6-minute walk test), we used an alternative exercise (the 2-minute step-in-place test), which can be used in smaller environments.

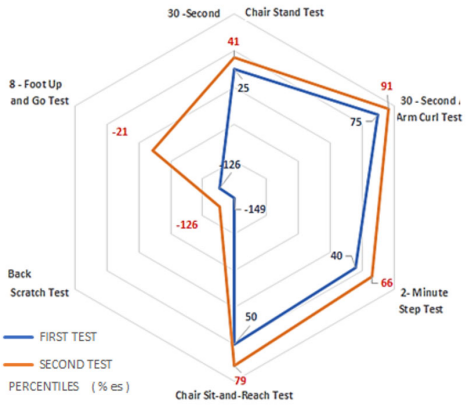
However, the collected data was not compatible with the reference tables and the only way to compare the data was to translate the findings into percentiles.

Subsequently, the verifiable improvements by the radar graph were calculated in the summary table. Specifically, the improvements are: Leg strength and resistance 16%, Arm strength and resistance 16% global resistance 28%, flexibility 29%, arm mobility 23%, agility 105%.

Table 10. Senior Fitness Test (Rikli & Jones, 2013) and Graph 5 show improvement in the body's muscular tone (Rikli & Jones, 2013)

Senior Fitnes Test Result

N.	TEST		FIRST TEST PERCENTILES (% es)	SECOND TEST PERCENTILES (% es)	WHAT IT MEASURES
1	30 -Second Chair Stand Test		25	41	LEG STRENGTH AND ENDURANCE
2	30 - Second Arm Curl Test		75	91	ARMS STRENGTH AND ENDURANCE
3	2- Minute Step Test		40	66	GLOBAL RESISTANCE
4	Chair Sit-and-Reach Test		50	79	FLEXIBILITY'
5	Back Scratch Test	-	149	-126	ARMS MOBILITY
6	8 - Foot Up and Go Test	-	126	-21	AGILITY



TEST	First TEST			Second TEST			DATA COLLECTION AND % es CALCULATION				REFERENCES % es AND RELATED INDICATORS				DIFFERENCE		
	Below average < 25% th	Average 25 -75 %th	Above average > 75% th	Below average < 25% th	Average 25 -75 %th	Above average > 75% th	Test results 1	% es calculated 1	Test results 2	% es calculated 2	1 % es	25 % es	75 % es	100 % es	PERCENTILE	NUMERIC	unit of measure
1		1			1		12	25	14	41	9	12	18	21	16%	2	Qt.
2		1				1	21	75	23	91	12	15	21	24	16%	2	Qt.
3		1			1		95	40	111	66	72	86	116	131	26%	16	Qt.
4		1				1	0	50	3,5	79	-6	-3	3	6	29%	3,5	Cm.
5	1			1			-30	-149	-27	-126	-11	-8	-1	2	23%	-3	Cm.
6	1			1			660	-126	365	-21	338	307	243	211	105%	-295	Sec.

REFERENCE : TEST 1 20/1 TEST 2 1/4 Average percentile improvement 22% Unconsidered

SF-36 (Short-form 36 items Health Survey) (GLOBE fisioscience, 2022) is a questionnaire on the state of health, characterised by brevity (on average, the subject takes no more than 10 minutes for completion) and precision (the tool is valid and reproducible). Born from the Medical Outcome Study (MOS), it was prepared for a population with chronic health problems, including the elderly. There are many versions of the MOS that are best known as the short form of 36 items, called SF-36, which contains eight of the 40 dimensions considered in the primary study, divided into 36 questions. All SF-36 questions, except one, refer to a period of four weeks preceding the completion of the questionnaire. The 36 questions conceptually refer to eight health domains and a single demand for change in the state of health (CS):

Table 11. F-36 Data analysis (GLOBE 2022)

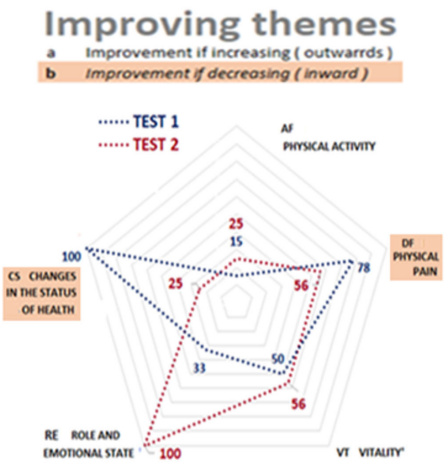
DATA ANALYSIS - GRAPHICAL REPRESENTATION - DATA TRANSFORMATION LOGIC

Medical Outcomes Study (MOS) 36-Items Short-Form Healthy Survey SF-36

QUESTIONNAIRE DATA PROCESSING

No. 00000 04/02/1957

theme song	description	refer back to me	Percentile (%) TEST 2	Percentile (%) TEST 1	points TEST 2	points TEST 1
AF a	PHYSICAL ACTIVITY Improvement if increasing	MAX 30 MIN 10 MED 20	25 %	15 %	15	13
RF a	PHYSICAL HEALTH ROLE Improvement if increasing	MAX 8 MIN 4 MED 6	0 %	0 %	4	4
DF b	PHYSICAL PAIN *Improvement if decreasing*	MAX 11 MIN 2 MED 7	56 %	78 %	7	9
SG a	HEALTH IN GENERAL Improvement if increasing	MAX 25 MIN 5 MED 15	75 %	75 %	20	20
VT a	VITALITY' Improvement if increasing	MAX 24 MIN 6 MED 15	56 %	50 %	16	15
AS a	SOCIAL ACTIVITY Improvement if increasing	MAX 10 MIN 2 MED 6	63 %	63 %	7	7
RE a	ROLE AND EMOTIONAL STATE Improvement if increasing	MAX 6 MIN 3 MED 4,5	100 %	33 %	6	4
SM a	MENTAL HEALTH Improvement if increasing	MAX 36 MIN 6 MED 21	53 %	53 %	22	22
CS b	CHANGES IN THE STATUS OF HEALTH *Improvement if decreasing*	MAX 5 MIN 1 MED 3	25 %	100 %	2	5



Graph 6. Improving information (GLOBE 2022)

The analysis of the extent of the improvements is as follows:
- by an increase in the percentile value (towards the external limit in the previous radar graph):
  AF PHYSICAL ACTIVITY from 15 to 25 with an improvement of 10%
  going from JUST ABOVE THE MINIMUM to BETWEEN MINIMUM AND AVERAGE
  VT VITALITY' from 50 to 56 with an improvement of 6%
  going from ABSOLUTE AVERAGE to JUST ABOVE AVERAGE
  RE ROLE AND EMOTIONAL STATE from 33 to 100 with an improvement of 67%
  going from ALMOST MEDIUM to ABSOLUTE MAXIMUM

by decreasing the percentile value (towards the centre of the previous radar graph):
  DF PHYSICAL PAIN from 78 to 56 with an improvement of 22%
  going from BETWEEN AVERAGE AND MAXIMUM to JUST ABOVE AVERAGE
  CS CHANGES IN THE STATUS OF HEALTH from 100 to 25 with an improvement of 75%
  going from ABSOLUTE MAXIMUM to BETWEEN MINIMUM AND AVERAGE

			T 2%ile	T 1%ile	Δ %es
physical state	AF	PHYSICAL ACTIVITY	25	15	10
	RF	PHYSICAL HEALTH ROLE	0	0	0
	DF	PHYSICAL PAIN	56	78	-22
	SG	HEALTH IN GENERAL	75	75	0
mental state	VT	VITALITY'	56	50	6
	AS	SOCIAL ACTIVITY	63	63	0
	RE	ROLE AND EMOTIONAL STATE	100	33	67
	SM	MENTAL HEALTH	53	53	0
	CS	CHANGES IN THE STATUS OF HEALTH	25	100	75

In summary

			Δ
physical state	39%	42%	3%
%es	156	168	
mental state	68%	50%	18%
%es	272	199	

Note: determination of the percentage value (%) from the sum of the percentiles (%es) of the domain : [% = ∑%es / 400]

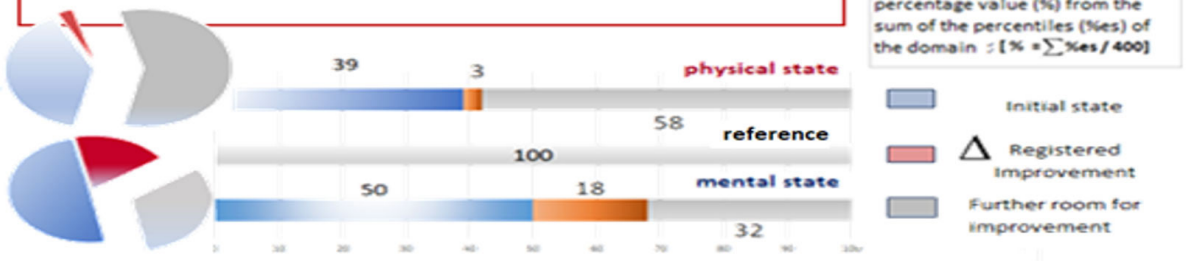


Table 12. F-36 and Figures 4. and 5. improvement evaluation. (GLOBE 2022)

FORMAT DAY (original evaluation analysis)
The original fomat was prepared to analyse the effects of *Gensoku* performance to highlight any counter-productive effects; the state was described by the study case volunter.

FORMAT DAY		PAIN														TIREDNESS															
		AFTER				EVERING				NIGHT				MORNING				AFTER				EVERING				NIGHT				MORNING			
PHYSICAL STATE	RIGHT ARM	1	1	1		1	2	1			1			2	2			2		1	2	2			1					2			
	LEFT ARM					0												1		1	2	1			1					1			
	NECK			1		0	1	1			1	1			1			1		1	2	1			1			1					
	CCHEST	1				1												1		1	2	1			1							
	BACK	2			2	2												2		1	2	2			1					2			1
	ABDOME	1				1	1				1				1			1		1	2	1			1					2			
	BUTTOCKS					0	1				1				1			0		1	2	0			1								
	RIGHT LEG	1	1	1		1	2	1			1				2	2		2		1	2	2			1					2		2	1
	LEFT LEG	1			1	1												2		1	2	2			1					1			
(a) 09/03/2024 - (b) 11/03/2024		(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
(c) 18/03/2024 - (d) 19/03/2024	(Note) Enter: 0 = none; 1 = negligible; 2 = important; 3 = unbearable.																																

Table 13. Format Day data (original)

“Pain, mostly localised in the right arm, neck, back and right leg, recorded throughout the day (after training, in the afternoon, at night and in the morning of the following day), from negligible to significant, became absent with the exception of the back and of the right leg, always present after training. The generalised tiredness over the whole body, always presented as negligible or important after training, initially slowly eased until it disappeared, and subsequently, the process became faster. Even the tiredness, as reported for the pain, although easing, remained in the back and right leg.” All this is in line with the result reported for the DF PHISICAL PAIN domain (SF-36).

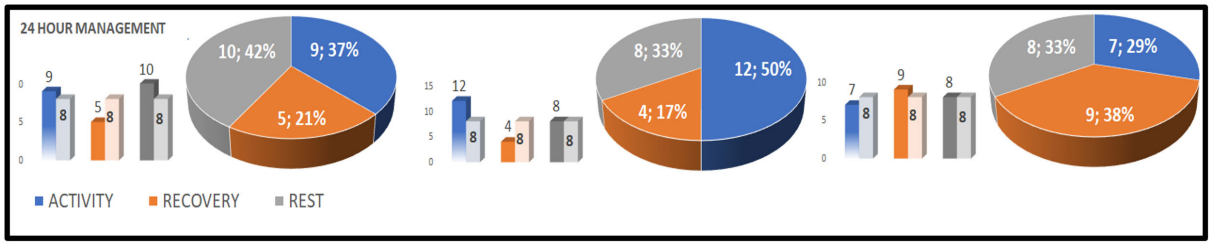
LOCOMOTION	STEPS								AMOUNT	EQUILIBRIUM								TODAY HOURS											
	NUMBER				RHYTHM					STATIC				DYNAMIC				ACTIVITY				RECOVERY				REST			
	2ND		nd		1		3	3		2	2	1	3	1	3	1	3	9	12	7	7	5	4	9	9	10	8	8	8
	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)		(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)	(a)	(b)	(c)	(d)
(Note) Enter: 0 = good; 1 = sufficent for improvement; 2 = sufficent but constant; 3 = got worst.																													

Table 14. Locomotion and equilibrium data (GLOBE 2022)

The data reported on the format day was not comforting data regarding locomotion and balance, in contrast to what was detected during the gym tests, where improvements were evident and documented.

This leads to the sole deduction that the participant must modify the rhythms of daily life by appropriately alternating activity times with adequate rest. Planning of daily work with the right recovery times for longer or heavier work, in line with the logic contained in the execution protocol and the awareness of accepting no activities above one's own forces, can make a subject's life less tiring, more manageable, and less painful.

Figure 6. Example of % distribution of activities during the days 09/03/2024, 11/03/2024, and 18-19/03/2024.



Pie chart referring to the % distribution of activities during the day. Bar graph of hours of activity during the day in relation to the 8-8-8 type distribution.

RESULTS DISCUSSION

Comparison with previous research

To the best of our knowledge, there are very few applications of judo specifically for Parkinson's Disease, with no execution of the falling technique. (Sakuyama et al., 2021). While much research has been conducted on the benefits of physical exercise in people with Parkinson's Disease, specific studies focusing on judo are not as common. Music and dance therapy can alleviate freezing gait. Several studies have demonstrated the successful use of integrative strategies for improving patient accessibility and participation. (Rafferty et al. 2021). Some studies have highlighted the potential benefits of judo training for brain function related to physical and cognitive performance in older adults (Adler & Ahlskog, 2000). Judo, as an open-skill discipline, requires excellent cognitive function, such as executive function, processing speed, working memory, and learning, in addition to excellent physical ability to adapt to a continually changing environment (Sacripanti, 2021). All these aspects could help improve motor skills and cognitive function in individuals with Parkinson's.

Discussion

The results clearly support the initial hypothesis that *Gensoku-No-Genkei* can be used as a therapeutic tool for functional improvement in patients with PD, even in an advanced state. The confirmation can be deduced quantitatively from the results and trends of the graphs which clearly show a decrease in the general execution time (Graphs 1. and 2.). This is also confirmed by the times for standing up from the right and left falls (Tables 2. and 3.), which show an interesting time percentage decrease of the total 10 falls of *Gensoku*, both as a total time and average time: 53% and 45% on the right and 57% and 51% on the left, respectively.

Interestingly, the improvements between the global best and worst times of *Gensoku* as tori are very similar to those of *uke*; there is a little prevalence of left on the right; 34% vs 38%. The slight but consistent better result of the left over the right side is due to the roto-flexion of PS accentuated towards the right side, which implies a weakening of the muscles acting under unnatural angles. The results were also supported by the tests performed for both the classic tests (Graphs 3.and 4.) 'sit up and go' and 'walk for 20 metres' and the judo falls tests. In addition, PS was improved by bringing the lateral roto-flexion from the previous 14° to the current 11° (Figures 2. and 3.) without any specific treatment.

Strengths

Regarding the follow-up assessment of pain after the execution (Format Day), an improvement was observed, with pain eventually subsiding in some cases (see Table 13). Mood and cognitive impairments associated with Parkinson's disease did not deteriorate, according to the self-analysis results (Tables 9. and 10.). This study demonstrates that the judo sequence *Gensoku-No-Genkei* may be efficacious as a therapeutic tool for individuals with Parkinson's disease. The patient exhibited significant improvement in balance, co-ordination, and reduction of Pisa Syndrome symptoms.

Limitations

This exploratory study, conducted for the first time and developed as a single case study (Gerring, 2006), aimed to evaluate the potential efficacy of a judo sequence called *Gensoku-No-Genkei* as a therapeutic tool for Parkinson's Disease.

Several limitations of this pilot study are inherent to its nature, as a single case study, which restricts the generalisability of the results. For instance, the absence of a control group impedes the comparison of results and the assessment of the therapy's effectiveness beyond this individual case. Additional limitations include: the reliance on subjective patient evaluation, which may introduce bias in the assessment, and the absence of objective medical analysis of the subject during the experimental phase. Moreover, the study did not incorporate long-term follow-up of the patient post-intervention. These identified limitations can be addressed through further research involving larger samples, control groups and long-term follow-up assessments.

Theoretical Implications

This approach shows the potentially profound impact of judo on Parkinson's patients and sheds light on an innovative approach. In addition to the well-known cardinal symptoms (Albin & Roger, 2022), there is a loss of spontaneous movement, a reduction in blinking, a marked reduction in facial expressions, a lowering of the vocal tone and a change in writing that tends to become smaller. Motor symptoms can exhibit asymmetric presentation (Albin & Roger, 2022) and *Gensoku* as a therapeutic tool can address and improve movement alterations through the adjustment of dysfunctions in the musculoskeletal system, possibly utilising well-known brain plasticity.

Practical Implications and future direction

If the validity of *Gensoku* is confirmed, after more complete scientific investigations, it could be added to the already rich system of existing therapeutic and rehabilitation methods. However, *Gensoku* seems to have many more advantages than conventional treatments accepted and employed today.

Wider and more complete multidisciplinary research on a wider base of subjects with Parkinson's Disease.

CONCLUSION

Gensoku as a therapeutic tool can elicit the following physiological responses:

Increased strength and muscular endurance, pain reduction potentially attributable to decreased inflammation, and enhanced tissue relaxation. These effects contribute to an improvement in overall physical condition.

The outcomes may vary depending on the stage of Parkinson's Disease and the reactive capacity of the individual. Based on this quantitative experimental study and its results, it can be concluded that *Gensoku-No-Genkei*, conceptualised as complex bilateral training for patients with PD, when appropriately dosed over time and interspersed with adequate recovery periods, positively stimulates neuro-plasticity in patients with PD.

Gensoku-No-Genkei, when implemented correctly, contributes to the deceleration of symptoms and, more significantly, to a partial recovery from global motor deterioration. This has substantial implications for patients' activities of daily living. Consequently, judo can be considered an effective complementary tool to support medical therapy for patients with Parkinson's Disease. This assertion was corroborated by the collected quantitative data. The identified limitations can be addressed through further research involving larger samples, control groups and long-term follow-up assessments. Additional and more comprehensive studies, conducted in accordance with accepted scientific principles and controlled experiments, are therefore necessary to provide a more definitive evaluation of these claims.

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